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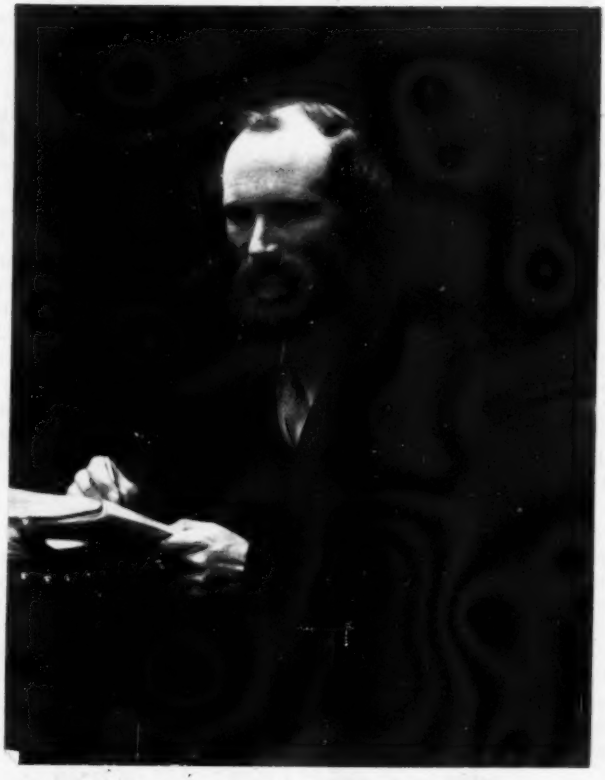

FROM A PHOTOGRAPH BY MR. J. FERGUS, LARGS.

SIR WILLIAM THOMSON.

SIR WILLIAM THOMSON was born at Belfast on June 25th, 1824. In 1832 his father, Dr. James Thomson, was appointed Professor of Mathematics in the University of Glasgow, having formerly held a similar position in the Royal Belfast Academical Institution. William began his college course in Glasgow at the early age of eleven, and soon gave proof that he possessed mathematical genius of a high order. His Glasgow course over, he proceeded to Cambridge, where in 1845 he graduated as second wrangler and first Smith's Prizeman, and was immediately elected to a fellowship of his college—St. Peter's.

He then spent some time in the laboratory of Regnault, in Paris, but soon a vacancy occurred in the chair of Natural Philosophy in Glasgow University, and Thomson became a candidate. In spite of his extreme youth, the brilliant reputation which he had already won at Cambridge

secured his election, and in 1846, at the age of twenty-two, he returned as Professor to the college which he had quitted as student only a few years before, and for thirty years he has continued to hold this position. Long before he left Cambridge, or had entered on legal manhood, he had exhibited, in the publication of papers on scientific subjects, an originality and industry that would put Macaulay's schoolboy to the blush. When only seventeen years old he wrote a paper "On the uniform motion of heat in homogeneous solid bodies, and its connection with the mathematical theory of electricity," which was published in the Cambridge *Mathematical Journal* for 1842. In this paper Thomson showed the identity of the laws of distribution of electric or magnetic force in general with the laws of distribution of the lines of motion of heat in certain special circumstances. This communication was speedily followed by a series of others on the mathematical theory of electricity, of which we can only mention a very few. In 1845 he pointed out that the experimental results of Snow Harris, which at that time were held by many to be opposed to the laws of electro-static attraction and repulsion laid down by Coulomb, were really in full accordance with Coulomb's laws. In the same paper we find the first mathematical development of Faraday's conception, that inductive action takes place by means of a dielectric medium (and not as "action at a distance")—a conception which, in Faraday's hands, had already led to the discovery of that property of dielectrics called by him their specific inductive capacity. In the same year Thomson invented the theory of *electrical images*, which he has developed into a method of great power in the solution of problems in electro-statics. Many other papers followed, showing mathematically, and independently of all hypothesis, how the electro-static action of conductors was affected by changes in their shape and relative position. The subject of electro-kinetics, too, Thomson attacked with equal originality and success, aided by Weber's suggestion of measurement in *absolute* units, and from the point of view of the theory of the conservation of energy, which in his own and other hands was at that time making prodigious advances. Of his place in connection with the development of this great principle we shall speak farther on; at present we hasten to refer to his connection with submarine telegraphy.

In 1854, when the practicability of a cable across the Atlantic was under discussion, his attention was drawn to the retardation of signals which (although pointed out by Ronalds as early as 1823) was first observed on the Hague cable, and experimentally explained by Faraday. Thomson investigated the phenomenon mathematically, and enunciated the well-known law that with any given *core*, the retardation of signals in a cable is proportional to the square of the length. In the same paper he gave diagrams showing the theoretical form of the *curve of arrival* of an electric impulse at the distant end of a long cable, and pointed out the conditions necessary, from an electrical point of view, to ensure success in the Atlantic wire.

Besides its intrinsic value, this paper is of special interest on account of its being, indirectly, the means of bringing Professor Thomson into connection with practical telegraphy. In 1856 Mr. Whitehouse, the electrician to the Atlantic Telegraph Company, misinterpreting the results of some of his own experiments, disputed the accuracy of the law of squares, and Thomson replied in a letter to the *Athenæum*. The directors of the company soon saw that the theoretical knowledge and experimental skill of the Glasgow Professor ought to be enlisted in aid of their difficult enterprise, and he, in his turn, took up the work with characteristic energy.

Convinced that if the Atlantic cable was to be a commercial success, signals must be transmitted through it at a much more rapid rate than would be possible if each electric wave were allowed to issue from the distant end before its successor entered the cable, Thomson gave his attention to the practical problem of inventing a receiving instrument, which would not only give readable signals under the action of very feeble received currents, but would also indicate clearly any succession of electric impulses, following each other so quickly as to be superposed. These conditions were fulfilled in the *Mirror Galvanometer*, which he invented in 1857. This instrument is too well known to electricians to need description. The conception of magnifying the almost invisible motion of the needle by the use of a long beam of light, which, besides being a pointer with no inertia, travels twice the angular distance that a material pointer of the same length would travel, was as brilliant as it was happy.

In the same year he was the first to publish, in the *Engineer* newspaper, the true theory of the mechanical forces concerned in the laying of cables, and to point out that when a cable is laid in a uniform depth and at a uniform speed, it forms a straight line from the point where it enters the water to the bottom; and also to give the first suggestion of an accurate method of testing the insulation of cables in a lecture to the British Association at Dublin.

Undaunted by the failures of 1857, and after an experimental trip to the Bay of Biscay, to test the efficiency of the paying out machinery, the *Agamemnon* and *Niagara* resumed in 1858 the attempt to connect Ireland with America, Thomson being on board the *Agamemnon*. After three more failures came success, and on the 5th of August the cable was completed, but not before indications of very defective insulation had been given by the tests on board both the ships. From that time the faulty cable lived on feebly, the only readable signals being those received on the mirror galvanometer, until, on October 20th, it breathed its last, in a vain attempt to tell Valentia that Newfoundland was sending with three hundred and twelve cells!

During the interval from 1858 to 1865, when the next trial was made, much was done in the way of mechanical and electrical improvement. One of the most important steps was the appointment, by the British Association, of a committee to determine what should be adopted as the unit of electrical resistance, and how this unit should be represented in a standard. It was at Thomson's suggestion that this committee was formed, and he remained a leading member of it for the eight years of its existence, during which it effected a great deal more than was dreamt of on its first appointment. The establishment of the well-known system of "B. A. units" was one of the fruits of its work, which not only fully supplied the wants of practical telegraphy, but gave to pure science a new exactness, and many powerful aids to research. In addition to this, not a few valuable contributions to submarine telegraphy were made in the evidence taken by the Parliamentary Commission which sat during part of the interval. In 1865, the attempt to lay an Atlantic cable was again renewed, this time by the *Great Eastern;* but the attempt resulted in the loss of the cable—a loss which Thomson firmly believed to be only temporary, the experience already acquired and his theoretical investigation of the subject both convincing him that it was perfectly possible to grapple for the lost cable, and raise it to the surface. Many of the other engineers shared his confidence, and in 1866 the justness of their views received triumphant proof, when, after the successful submersion of a new cable, the cable of 1865 was recovered and completed. On the return of this expedition, Thomson and several of his distinguished colleagues received the honour of knighthood.

The desirability of permanently recording signals instead of merely producing them so as to be read at the instant of production by an attentive clerk, early led Thomson to seek some means of marking the deflections of the indicator upon a strip of paper. Obviously, the conditions of the case were such that no friction was permissible. His first proposal was to make permanent marks by means of sparks from an induction coil, given off by the point of the moving indicator. This plan was not fully successful. But in 1866 he hit on a method which answered admirably, and which was perfectly original, namely, to cause ink to be spurted off from the point of the indicator by keeping it in a state of constant electrification. This system resulted, after a long process of development, in the *Siphon Recorder*, which has now supplanted the mirror in the working of most of the great submarine lines.

In 1865 Sir W. Thomson, Mr. C. F. Varley, and Professor Fleeming Jenkin combined their various telegraphic inventions, thus giving a complete system of working long submarine lines, which has since remained the only one in use. An extension of patent rights was granted by the crown in 1871. Thomson and his partners had for long endeavoured to reduce to a practical shape the principle of "curb" sending, or sending by means of combinations of reversed currents, the object being to diminish retardation and so secure greater speed and clearness. This method has within the last year been brought to a thoroughly effective condition by Thomson and Jenkin, in their *Automatic Curb-sender*, which is already in use by the Eastern Telegraph Company.

Thomson's improvements on *Electrometers* began almost simultaneously with his criticisms of the experiments of Snow Harris, to which we have already alluded. In 1857 he published in the memoirs of the Roman Academy of Science a description of a divided-ring electrometer, based on the old electroscope of Bohnenberger. This was the earliest form of his beautiful *quadrant* electrometer, which has since been perfected by a long process of natural selection, and is an excellent example of its author's constructive skill. The quadrant electrometer is now superseding the galvanometer in many departments of electrical testing. Its application to the exact and easy measurement of insulation resistance was first made under Thomson and Jenkin, in the testing of the Western and Brazilian cables in 1872.

Besides the quadrant electrometer Thomson has invented many other forms, each suited for some special field of electro-static research. Thus, the *portable* electrometer is adapted for observations of atmospheric electricity, a department of meteorology to which Thomson has given much attention, and which is indeed a creation of

(Continued on page 5.)

STATE OF THE TELEGRAPH SYSTEM IN EUROPEAN COUNTRIES.*

Country.	Year.	Extent of surface in square kilometres.	Entire population as per last census or by calculation.	State telegraph system.		Offices.		Personnel.	Apparatus.
				Lines.	Wires.	State.	Rly. & Private.		
				Kilometres.		Stations.		Number.	
Great Britain & Ireland..	*a* 1875	315325	31845379	38858·0	176352·7	3741	1866	11605	11988
Denmark	1875	38237	1784741	2780·0	7653·0	114	89	299	233
Norway	1874	316694	1760000	7060·0	11248·0	107	63	623	286
Sweden	1875	444846	4250412	7959·4	19377·4	170	351	714	475
Russia (the whole)	1874	20729411	86722000	62350·0	120522·0	715	900	6159	1754
Austria—Hungary	1875	624045	35904435	36262·4	108147·0	1341	1758	4689	2956
Territory of Reichsrath	1875	300191	20394980	21926·0	59977·9	979	1233	3354	1653
Do. Hungarian Crown	1875	323854	15509455	14336·4	48169·7	362	525	1335	1303
Switzerland	1875	41418	2669147	6334·0	15442·6	892	110	1557	1349
Germ. Empire (Reich	1875	449536	35850573	35708·4	132009·7	1945	2393	*g* 460	4477
Germ. Empire (Bavaria	1874	75863	5024832	7146·4	18359·0	668	111	*h* 362	1259
Germ. Empire (Wurtemberg	1875	19508	1881505	2480·6	6236·8	328	10	154	538
Holland	1875	32875	3674402	3440·4	12332·5	159	171	1082	379
Luxembourg	1874	2587	197528	290·0	445·0	16	22	34	26
Belgium	1875	29455	5283821	4959·0	21094·0	503	83	1769	1088
France	1875	528577	36102921	51614·9	135944·3	2767	1499	5510	5069
Portugal.....	1874	92753	4367882	3317·0	7450·0	126	10	686	244
Spain	1873	507036	16798925	11754·0	26728·3	196	26	1826	385
Italy	1875	295335	26801154	20756·0	62224·0	1128	825	4202	3200
Greece	1875	50212	1457894	2565·0	3165·0	60		333	120
Turkey	1875	369257	9791582	25232·0	48650·0	397	47	2894	1240
Roumania	1875	121154	4800000	3820·6	6842·4	83	84	*k* 988	212
Servia.....	1874	43555	1338505	1461·3	2145·5	37		255	52

* These Tables have recently been constructed and published by the German Government.

Country.	Year.	Traffic.				Receipts.	Expenditure.	
		Charged.		Uncharged and Service.	Total.		Ordinary.	Extraordinary.
		Home.	Foreign.					
		Telegrams.				Marks.	(Mark = about 1s.)	
Great Britain & Ireland..	1875	18433092	2331486	*b* 298490	21062978	25533240	20829500	*c* 183270500
Denmark	1875	385282	501635	25393	912310	656824	656062	132824
Norway	1874	470236	246586	44604	761426	878996	922204	339836
Sweden	1875	743060	359285	*d* 285372	1387717	1565676	1478906	239466
Russia (the whole).....	1874	2900330	669276	207935	3777541	15641848	12786788	1210240
Austria—Hungary.....	1875	4473445	1717035	613069	6803549	7598512	10131580	459022
Territory of Reichsrath	1875	2762311	1398429	387090	*e* 4547830	5510180	7142612	459022
Hungarian Crown.....	1875	1711134	318606	225979	*f* 2255719	2088332	2988968	
Switzerland	1875	1846898	834486	68079	2749436	1646561	1457864	180274
Germ. Empire (Reich	1875	7114095	3506118	515414	11195627	10258530	13498428	2460114
Germ. Empire (Bavaria	1874	734828	965639		1700467	1046354	967358	582110
Germ. Empire (Wurtemberg.....	1875	312706	472259	123660	908625	441000	458700	150276
Holland	1875	*i* 1601711	755444	17771	2374926	1264972	1915302	133050
Luxembourg	1874	19512	41498	1799	62809	28388	37774	23678
Belgium	1875	1929945	941945	1245547	4117437	1678490	1915302	64142
France	1875	6988832	2630031	1360000	10981863	12805710	10890000	356000
Portugal.....	1874	244031	167107	70010	481148	369186	674378	92538
Spain	1873	1124239	108165	51503	1283907	2075626	3134860	
Italy	1875	4460924	904978	*j* 205944	5571846	5737220	4660728	512000
Greece	1875	191523	52931	5759	249673	290054	343994	31780
Turkey	1875	491898	230338	448520	1210750	4881413	3920528	38868
Roumania	1875	615812	196212	165245	977269	584906	*l* 2552458	60922
Servia.....	1874	95002	56880	13374	165256	119234	269190	22272

a. Condition at the end of March, 1876. *b*. Uncharged telegrams. *c*. Entire cost, including purchase price of private telegraphs. *d*. 28,908 of these service telegrams. *e*. The 364,223 sent from Hungaria to Austria, and the 37246 sent from and to Hungaria through Austria are not included. *f*. Exclusive of the 361,698 telegrams sent, from Austria to Hungary. *g*. In the combined stations those served by the post-office are not included. *h*. Personnel of the independent stations. *i*. Including 160,196 telegrams which have not passed on the state lines. *j*. Including 69,187 uncharged state telegraphs. *k*. Including the officials of the post-office at the combined stations. *l*. Including the expenditure on post-office officials entrusted with telegraphic service.

his own. He devised the *absolute* electrometer as early as 1855, for the purpose of putting in practice a plan for measuring differences of potential in absolute electro-static measure described by him two years before. By this instrument he succeeded in literally *weighing* the attraction between two discs at different electric potentials, and in determining the electro-motive force required to produce a spark in air, and in 1869 he applied it to the determination of the ratio between the electro-static and electro-magnetic systems of units, a subject of great interest in its bearing on the electro-magnetic theory of light. His improvements in electrometry have enabled him to give two distinct proofs of the contact theory of electricity; and he has even been able by the same means to approach so abstruse a problem as the calculation of the size of atoms.

We can only mention, in connection with Thomson's services to electricity, his researches on the electro-dynamic qualities of metals, described in a communication to the Royal Society which forms the Bakerian lecture for 1856, and contains his remarkable discovery of the electric convection of heat. His papers on "Electro-statics and Magnetism" were reprinted in a collected form in 1872; but unfortunately this yet remains to be done for his memoirs on other subjects. We propose to complete this notice by giving, in our next number, a short account of the work done by Sir William Thomson in other departments of science.

CONVERSAZIONE OF THE SOCIETY OF TELEGRAPH ENGINEERS.

THE annual conversazione of this Society took place at Willis's Rooms, St. James's, on the evening of Monday, the 18th ultimo. The entertainment was on this occasion provided by the President and Council of the Society. Over a thousand invitations were issued, and the spacious ball-room was well filled throughout the evening. The number present, which exceeded 600, and the high character of the instruments and other applications of the science exhibited testify in a most gratifying manner to the success of the institution. Founded scarce five years since, it now numbers over 800 members and associates, and has enrolled within its ranks the chief electricians of the day. Cultivating, at the same time, by means of its Foreign Honorary Secretaries, connections throughout the globe, its sphere for usefulness and the general dissemination of ideas and works of interest to the profession bids fair to be as spacious as its most ardent admirer can wish; and, conducted with that spirit and energy which has hitherto characterised its management, it may well be looked forward to as forming the future main centre for the discussion and consideration of all questions of importance and interest to the science.

The guests were received at the entrance of the large ball-room by the President, Mr. C. V. Walker, F.R.S., Professor Abel, F.R.S., the president elect, and other members of the Council. The gathering included almost every one of any prominence in the electrical world, with numerous others, lovers of the science. Amongst others may be noticed Sir Charles Bright, Mr. Latimer Clark, C.E., Mr. Robert Sabine, C.E., Lord Paulett, Dr. C. W. Siemens, F.R.S., Mr. W. H. Preece, C.E., Mr. Bramwell, C.E., F.R.S., Mr. Carl Siemens, Mr. H. Weaver, Mr. Spottiswoode, F.R.S., Sir James Anderson, Mr. Willoughby Smith, Mr. E. Graves and Mr. C. B. Patey, of the Postal Telegraph Service, Mr. Chevalier, Lord de Blaquiere, Sir David Salomons, the Baron de Faille des Essart, and many others well known to the engineering and commercial circles of telegraphy.

In a room appropriated for the purpose was to be seen Mr. Apps's usual grand display of powerful induction coils and brilliant vacuum tubes; an electric galvanometer, designed by Mr. Latimer Clark, of the most delicate construction, intended mainly for lecture purposes; whilst at the same time some very beautiful experiments, for the purpose of determining very minute intervals of time, and others for ascertaining the contour and speed of the electrical wave in telegraph cables, were carried out by Mr. Robert Sabine, C.E., personally, the cables being represented by condensers of various capacities.

In the main room were to be found the principal of the exhibits. The President's contributions were numerous and interesting, containing some items of historical value. There was a series of thirty-six insulators, beginning with the earliest form used, a single needle-coil and indicator constructed prior to 1845; the first piece of wire covered in England with gutta percha; whilst in actual working were the South-Eastern block-signals, train describers, electric repeaters, and passenger and guard communication. A new form of mariner's compass, the object of which is to enable the mariner to dispense with solar observations, exhibited by Sir William Thomson, necessarily attracted some attention. The scale is marvellously lightly suspended, the friction of its pivot being thus reduced to the veriest minimum. In this exhibit also the Thomson and Jenkins Automatic Curb-sender and Puncher, by means of which the working capacity of a submarine cable is increased, drew many inquirers. The Eastern Telegraph Company provided an interesting collection of faults from their cables; and the Western and Brazilian Telegraph Company exhibited Mr. Jamieson's new form of grapnel for recovering submarine cables, the great merit of which is that whilst retaining the cable within its fangs, these fangs are so regulated that in coming in contact with rocks or other impediments at the bottom of the ocean, they expand and release themselves, returning to their regular position immediately on freeing the obstacle. This invention is one of interest to submarine telegraphy, and as it cannot be well illustrated without the aid of a drawing,

we propose at some future date to give it a more full and thorough description. In the meanwhile, it is worthy the attention of cable maintainers, and we are glad to hear it has already received good practical support.

Still in the field of cables and cable-work a very interesting exhibit was one made by Mr. W. H. Preece, of a piece of rock brought up when underrunning the Channel Islands cable for repair, firmly attached to it, and showing very clearly the impress made upon it by the cable. Mr. W. T. Henley showed an improved form of cable, and Mr. Ladd a pretty specimen of a combined key and switch, invented by Mr. Jamieson, for use in submarine cables, the object of which is to prevent the possibility of the switch current being left upon the cable, when not required for signalling. Mr. John Browning exhibited some highly interesting specimens, under microscopical observation, from deep-sea soundings taken for the first Atlantic Cable, as also some of the *Challenger's* soundings, showing the composition of the bottom of the ocean at the points at which the soundings were taken.

From Sir George Biddel Airy, the Astronomer Royal, were specimens of the Photographic Registers of the movements of the Declination and Horizontal Force magnets, and of the earth current galvanometers at the Royal Observatory, Greenwich, showing the correspondence existing between magnetic and galvanic disturbances; and Mr. H. Saunders furnished some interesting diagrams, now the property of the Society of Telegraph Engineers, showing the earth currents observed simultaneously at both ends of a broken cable between Suez and Aden, and also the effects produced during the Aurora Borealis displays on February 4th, 1872.

It is well known that the late Sir Charles Wheatstone was engaged, when seized with the illness which terminated his life, in investigating the circulation set up in mercury by deoxidation, from which it was his object to obtain an electrical recording instrument of extreme sensibility. Specimens illustrating the peculiar action by which he sought to effect this were exhibited, and formed a centre of attraction, as did some other exhibits by Mr. Robert Sabine.

Messrs. Cecil and Leonard Wray had also on exhibition their improved form of Thermo-Electric Pile; Messrs. Johnson and Phillips a new form of insulator, from which some wonderful results are said to have been obtained, equalling in insulation properties those of gutta percha. The insulator is so formed as to admit of its receiving a film of oil, which, coming between the point of connection with the wire and the point of support, is said to prevent the accumulation of moisture, and thus interpose a high resistance to the escape of the working current. Its practical application has, however, yet to be tested. An Electrical Rain Gauge and an Electrical Anemometer, by Mr. Horatio Yeates; Hearson's Patent Strophometer, for showing at a glance the number of revolutions per minute machinery is at any time making, used on cable expeditions both for the engines and paying-out gear, by Messrs. Elliott Brothers, also deserve notice; as does an electrical railway signal, for use out of doors on lines of railways, invented and exhibited by Mr. C. E. Spagnoletti, of the Great Western Railway.

The mere mention of these, some of the most interesting and useful of the exhibits of this successful gathering, has occupied so much of our space that we fear to trespass further; but it would be unfair were we to close the subject without reference to the two automatic systems of Telegraphy, for Fire and Police alarms which are at this moment before the London public; the object of which is to place within the reach of all a ready and cheap means of obtaining aid in case of fire, burglary, or for other obvious purposes. The first of these is that advanced by the Exchange Telegraph Company. Only one wire is used. A receiving instrument with an alarum is placed at the Police Station, Fire Brigade Office, or other selected spot, and at the residences, warehouses, or at certain spots on a policeman's beat, is arranged the call apparatus. To call for aid a small button, according to the requirements of the case —if for fire that for "fire," if for police, that for "police," and so on—has to be pressed. The pressure of this plunger or button does not send the signal, but winds up a spring or weight, which brings into position the set signal required to be made. If now the wire is free, that is, if it is not occupied by some one else, a current from the receiving office discharges the spring or weight, and the signal is sent by means of a disc, which under the influence of the spring is revolved, and which in the course of its revolution passes over certain raised studs which interrupt the current, so as to deliver the intended message at the receiving station, where it is recorded on a slip of paper. As soon as the spring has assumed its normal position, it cuts its instrument out of circuit, and the wire is free for the use of another house. Thus a number of communicating stations are strung upon the same wire, but only one message can be sent at one time, all the other instruments being restrained in their action till that which has possession of the wire has finished its work, when the next takes it up, and so on, till all is cleared off. There is, of course, one signal in common for fire, police, &c.; but a distinguishing number, or letter, for every communication, so that the receiving station may know whence the signal arises. It will be evident that any combination of signals may be made, and that by a system of adjustable type, various signals meeting the emergency of the occasion may be employed, and that by uneducated men. The system is very similar to that in use in New York. It is calculated to be of good service in all large towns and cities, and even for hotels, offices, and domestic purposes.

The other exhibit of the same nature was that of Messrs. Montefiore and Co., which effects precisely similar results with two wires.

In a previous impression we gave an account of the Electric Pen, the invention of an American electrician, Mr. Edison, of some note. We were glad to find specimens in operation, and to see them attract such general observation. Not only are these useful for writing, but also for etching purposes. Sketches were made on the spot, and reproduced under the press in any quantities, whilst the exhibitors, the Electric Writing Company had on view many pretty specimens of its work.

We cannot but look upon the gathering as in every way most successful, and one which will tend largely to extend the objects of the Society. Much thanks are due to the honorary and acting secretaries for their exertions in bringing together so admirable a display of objects of interest and novelty, and for the excellent arrangements which enabled so many to spend, what we feel must have proved, one of the most pleasant and interesting gatherings of the season.

A selection of excellent music was performed at intervals by the band of the Royal Engineers.

[We regret that our report of the last meeting of the Society is unavoidably postponed to our next number.]

Notes.

PROFESSOR ABEL, F.R.S., the President of the Society of Telegraph Engineers, will deliver his opening address at the Institution of Civil Engineers, 25, Great George-street, Westminster, on Wednesday, the 24th inst., at 8 p.m. The Society is to be congratulated on having secured as its President one who occupies so distinguished a position in the world of science and is so universally respected as Professor Abel; and on this occasion a rich treat may be anticipated.

A lecture on "Light and the Eye" was delivered by Prof. Dewar, of Cambridge, at the London Institution, on the 18th ult. Having shown by means of a Thomson reflecting-galvanometer the electrical effect of light on two plates of metal coated with chloride of silver, and also that the rays with greatest photographic effect had the greatest electrical effect, he made some experiments illustrating the electricity in muscular action. Two troughs of gutta percha filled with saline solution were connected by a skein of cotton-wool soaked in the solution. Clayey electrodes were inserted, and connected with a battery and the galvanometer; the movement of the light-spot showed the connection to be complete. The lecturer then substituted his own body for the skein to complete the circuit (without battery), dipping his hands in the troughs; and on contracting the muscles of the hand, the effect was like that of a battery action. Prof. Dewar showed the action of light on the eye of a recently killed frog; electrodes being applied to the eye and the lime-light being cast on it, a distinct electric effect was revealed by the galvanometer. He stated that he had made similar experiments on himself, one electrode being inserted in some saline solution over his eye (when in a horizontal position), and his hand completing the circuit connection. Varying amounts of light were let in on the eye, and the effects corresponded to those in the eye of a cold-blooded animal.

The *Manchester Evening News* says that the electric bell system has been carried out on a larger and more elaborate scale at the Manchester City Hall than in any building in which that apparatus has been adopted. Wire of more than ten miles in length has been extended throughout the Hall, all the departments being embraced by the system, while, however, each department has its own independent system.

At a recent meeting of the Royal Society, Dr. Burdon Sanderson read a paper on the mechanical effects and the electrical disturbance consequent on excitation of the leaf of *Dionæa Muscipula*. The first set of experiments were to determine the time that elapsed between touching one of the sensitive hairs and the first perceptible motion. The touches were given at intervals of two minutes. The first half-dozen produced no mechanical effect. Then twenty-five successive touches produced effects which variously took 7, 5, and 3 seconds before they caused actual motion. The twenty-sixth touch produced motion in 2·2 seconds, and at the twenty-seventh the leaf closed. It was found by attaching a one gramme weight that with each touch after closing the leaf clenched tighter. With regard to the electrical condition of the leaf, it is found that the external surface is positive to the internal. The electrical disturbance is strictly limited to the surface of the leaf, and does not extend to the petiole, which simply serves as an ordinary moist conductor. Experiments were also made to ascertain the centre of greatest electrical intensity in the leaf, and tables giving the results of many experiments had been drawn up. In animals only the nervous and muscular tissues are electro-motive; in plants, only the leaves. It was found, by shifting the needle-points to different parts of the leaf, that when one part was exhausted and would produce no effects, other parts would, thus indicating that the excitability of the plant is a property possessed independently by the protoplasm of every cell in the excitable area. Experiments have also been made as to the time that elapses between touching a hair and the manifestation of the electric disturbance, and it is found to be from one-sixth to one-eighth of a second. Similar experiments on other plants are promised.

A valuable German work, entitled, "Handbuch der Elektrischen Telegraphie," by Prof. Zetzsche, of the Polytechnical School in Dresden, is now in

course of publication. Two parts have appeared (one of each of the two volumes). One of these is entirely historical; the other is devoted to the subjects of electrical state, sources of electricity, stationary electric current, electro-motive force, resistance and heating effects of the electric current.

We are glad to hear that Mr. F. C. Webb, M.I.C.E., M.S.T.E., and who, it will be remembered, had conferred on him by the Emperor of Brazil the title of Knight Officer of the Rose, &c., has been appointed to H.M.S. Vernon, Captain Arthur, as electrician to the torpedo school. Mr. Webb's large experience renders him undoubtedly well fitted for such a position.

It is a curious fact (as the *Scientific American* points out) that the earliest system of telegraphy for signalling over long distances originated among the African negroes. It is still more remarkable that the means used were telephonic, and the signals were read by sound, and not by the eye, as in the case of the semaphore or other early signalling devices. The "elliembic," as the instrument used is termed, is still in existence, and has been in use from time immemorial in the Cameroons country, on the west coast of Africa. By the sounds produced on striking it, the natives carry on conversation with great rapidity and at several miles distance. The noises are made to produce a perfect and distinct language, as intelligible to the operator as that uttered by the human voice.

A good way of performing before an auditory Foucault's experiment of the stoppage of a rotating disc by the action of an electro-magnet has just been described to the Paris Academy by M. Bourbouze. The copper disc is fixed on the axis of a syren, parallel to the moving plate, and so as to rotate between the arms of an electro-magnet, which may be carried by the syren itself. A current of air is sent into the syren; and gives as usual a sound of rising pitch as the velocity increases. You then send the current into the magnet, and the sound at once completely ceases. M. Bourbouze, it may be mentioned, uses a special arrangement for working syrens. A reservoir of compressed air, fifty litres capacity, has a tube connected with it, having a fine extremity, and entering a conical and much larger tube; in the exterior tube holes are perforated as in the Bunsen burner, to produce a suction of air. With this arrangement much higher sounds can be had than with the ordinary bellows.

The Fuller battery, now extensively used, is a modification of the bichromate of potash battery. It consists of an exterior glass jar containing a solution of bichromate of potassium (1 part bichromate, 3 sulphuric acid, and 9 water), in which the carbon plate is placed. Inside of the glass jar is a porous cup, the bottom of which is covered with a layer of mercury to the depth of half an inch. The zinc is cylindrical in form, and terminates in a foot which rests in the mercury. The remaining portion of the porous cup is filled with a solution of sulphuric acid and water, one part acid to forty of water. The improvement claimed by the inventor consists in maintaining the zinc always standing in the mercury, which renders the battery very constant. Its electro-motive force is about double that of the Daniell, while its internal resistance is low, and, even when the exterior resistance is quite small, the battery remains remarkably constant.

We have received the "Precursor number" of a new weekly Journal called the "Inventor, Patentee, and Manufacturer," which "will give the latest and most exact information relating to Patents in a complete and comprehensive form, each Patent being traced through its different stages." It is also designed to be an advocate of the rights of inventors and of property in invention.

The traffic receipts of the Direct United States Cable Company for week ending 16th December, 1876, amounted to £3,700; 23rd December, £3,300.

Proceedings of Societies.

PHYSICAL SOCIETY—16TH DECEMBER, 1876.

Prof. G. C. FOSTER, President, in the chair.

THE following candidate was elected a member of the Society—Mr. W. Baily, M.A.

MR. CROOKES described some of the most recent results he has obtained in his experiments on the radiometer, and exhibited many beautiful forms of the apparatus, most of which have been devised with a view to decide on the correct theory of the instrument. He commenced by describing the arrangement he has used for some time past in studying the resistance offered by air and other gases to the rotation of a mica disc. From the normal atmospheric pressure to the best vacuum which can be obtained by the ordinary air-pump the resistance remains nearly constant, and the experiments have been carried on in vacua of remarkable perfectness, the highest exhaustion obtained being represented by one millimetre on a scale of ten miles, a point which was attained by means of a Sprengel pump with improvements by Mr. Gimingham, and measured by a McLeod gauge. Mr. Crookes concludes that in a perfect vacuum a mica plate would not continue to oscillate for ever, a fact probably due to the viscosity of the glass fibre employed. About 15 different forms of the radiometer were exhibited, and their inventor has satisfied himself that the theory of their action proposed by Mr. G. Johnstone Stoney is the only one capable of completely accounting for their action, and he considers it to be in all probability the correct one. As, on the molecular movement theory, the rotation is

due to a throwing off of particles from the blackened surface of the mica, it follows that, if a piece of transparent mica be attached to each fly in front of the blackened surface, the rotation will take place in the opposite direction, and this proved on experiment to be the case. As these facts can be explained on the "molecular movement" or the "evaporation and condensation" theory, Mr. Crookes arranged a radiometer having four transparent mica vanes, and mounted in a rather large bulb. At the side of the bulb in a vertical plane, a plate of mica, blackened on one side, is so fixed that the vanes can pass, and when light shines on this fixed plate, the fly is found to rotate, a fact which in itself disproves the latter theory. In conclusion, he exhibited a photometric four-vaned radiometer, in which the fly was attached to a small magnetic needle, and this might be so checked by an external magnet, that the strongest light would be incapable of causing the needle and vanes to make a half rotation. If the circumference of the globe be graduated and the apparatus be brought within the influence of a source of light, the angle to which the needle is deflected will be a direct measure of the intensity of the light.

PROF. DEWAR exhibited a simple electrometer, which he has designed, founded on a discovery of Lippman. If a capillary tube be immersed in mercury, and dilute sulphuric acid be placed in the tube above the mercury, and a current from a Daniell's cell be so passed through the liquid that the mercury forms the negative pole, the column will be depressed to an extent dependent on the diameter of the tube. In making an electrometer, Prof. Dewar has increased the sensitiveness by connecting two vessels of mercury by means of a horizontal glass tube filled with the metal, except that it contains a bubble of dilute acid. The instruments exhibited were constructed by Messrs. Tisley and Spiller, and Prof. Dewar showed that it is possible by means of them to measure an electro-motive force equal to one ten-thousandth of a Daniell's cell; forces capable of decomposing water must be measured by causing two currents to act against each other. The apparatus is very convenient, as it requires no preparation, and is extremely simple in its action. He then showed an instrument arranged by Mr. Tisley for producing a current, by the dropping of mercury from a small orifice into dilute sulphuric acid; if the vessels containing the mercury and the acid be connected by a wire, a current is found to traverse it. He then exhibited a manometer suitable for measuring very slight variations of pressure, and he illustrated the use of it for proving Laplace law that the internal pressure multiplied by the diameter of a soap-bubble is constant. It consists of a U-tube, one arm of which is about 15 inches long, and is bent horizontally and levelled with great care.

City Notes.

Old Broad-street, 30th December, 1876.

DURING the past month the subject most prominently before the public in connection with telegraph shares has been the attempt made by the Chairman and Directors of the Globe Company to persuade the shareholders in the Direct United States Cable Company to come to a joint purse arrangement with the Anglo-American Company. After the many abortive efforts which have already been made to swallow up the Direct Company, it seems almost incredible that any sane individual should again come forward and endeavour to convince the shareholders of the Company that now, when success has been already attained, and the future seems full of promise, is the time to hand over their undertaking to those who have all along been the bitterest enemies with whom they have had to contend. Nevertheless, Mr. John Pender has again stepped forward, and magnanimously submits a scheme in which he shows a desire to bury the hatchet, and smoke the pipe of peace with his rivals; this scheme, too, be it noted, has already received "*the approbation of the Board of the Anglo-American Company*." The proposal seems to us to very much resemble an offer from the second of one duellist to his victorious opponent, that provided the latter surrenders his sword, immediate death may not follow, but that he will possibly be dealt with as mercifully as the memory of his recent victory will admit of.

The Direct Cable Company was floated in the face of the most violent opposition. The contractors, it was confidently alleged, could never manufacture a good cable, or, if they did, they would never succeed in laying it. The good cable, however, was manufactured, and although the laying of it was anything but a success, yet it was ultimately accomplished.

The cable, instead of carrying ten words a minute through it, was found to have a transmitting power of over twenty; the insulation of the main section, when tested by Sir William Thomson, after being completed, showed the exceptionally high result of 5,445 million Siemens units per knot; while the conductivity and inductive capacity was as low as 3·05 Siemens units and ·409 microfarads per knot. The Company started well, and bade fair to speedily attaining a very high position as a commercial undertaking, when those mysterious breakages occurred, which, in the opinion of the highest authorities in England—Mr. Bramwell and Sir William Thomson—were *not* the result of accident.

Undaunted, the management of the Company commenced their long and arduous up-hill game; slowly, but surely, their forward steps have been taken, until now the Company has again reached—or, in fact, surpassed—the position which it previously held.

At the present day, 27 per cent. of the traffic passes over the Direct Company's Cable, and their receipts now average at the lowest estimate £187,000 per annum. Deducting working expenses, and allowing for the claim of interest, as well as for a reserve fund on the debentures, there can be no question that there is sufficient left to pay a handsome dividend on the ordinary paid-up capital. Now, the value of the shares of any Company will be governed by two factors. First, and that which undoubtedly exercises the most influence, is the immediate prospect of a good dividend. Secondly—and this is too often kept in the background—is the real chance of the undertaking ultimately proving to be and remaining a success. We have already disposed of the first of these, and so far as the second is concerned, the Direct shareholders have very little to fear. Let them only remain true to themselves, and their management and the future is well nigh assured; had they but another string to their bow, in the shape of a second cable, no sounder investment—so far as any telegraph investment can be considered sound—need be looked for.

We are far (while pointing out what we believe to be the true facts of the case respecting the Direct Company) from trying to depreciate the rival Anglo-American Company. That Company has already shown in the past what may be achieved by good management, and the errors which may have been committed before a capital of £7,000,000 could be said to be invested in the undertaking will serve, no doubt, as a warning against similar occurrences in the future. Rumours may, from time to time, be circulated as to the shaky condition and decreasing value of some of their five cables. Still, although no tests are published showing their actual condition, the despatch with which mes-

sages are transmitted over their system shows that there cannot be much wrong, and the daily statement of their receipts affords the most convincing evidence of the position of the Company.

There is ample room for both, and we believe that it would be a disadvantage, fraught not only with the greatest inconvenience to the public generally, but with evil to the shareholders of both Companies, were they blind enough to listen to the voice of the charmer, and allow even a single definite step to be taken in the direction of amalgamation.

A great deal has been heard of late about the West India and Panama Telegraph Company, and a "confirmatory" meeting was held yesterday, respecting which we may have a word to say in our next issue. Suffice it for the present to state that, as regards the two factors regulating the value of shares, to which we have referred above, the prospects of a handsome dividend on the capital of this Company are, we should say, infinitesimal.

The Western and Brazilian Company may also occupy a little of our attention in next number.

[It is proposed to continue the "City Notes" in the future numbers of the Journal. They will embrace a review of the commercial position held by, and the value from a scientific point of view of the plant belonging to those Companies which may be prominently before the public.—ED.]

INVENTIONS WANTED.

IF, instead of devoting so much time to the production of an infinity of car couplings and animal traps, and in ringing all the possible changes in bell-punches for car-conductors, inventors would look about them and endeavour to fill wants seriously felt, and the supply of which would be immediately and largely remunerative—the public would be greatly benefited, and capitalists saved a terrible amount of *boring*. Referring to the demands made by callers and correspondents of this office, we may say that a good machine for digging potatoes would pay; street-car motors are far from perfect, and steam ploughs and road locomotives, in this country, still further behind the requirements. There are no red or blue pencils worthy the name; india-rubber cannot be *de*-vulcanized on a paying scale; a power brake for freight-cars is needed; a cheap system of fire-alarm telegraphy would pay; Pittsburg and Wheeling call for smoke-consuming devices; steam fire-engine builders would use injectors capable of working with wet steam; portable gas-works supplying a fixed gas instead of a condensible vapour are loudly demanded; fire-hose is too heavy; there are few roofing materials that are light, tight, cheap, and sightly; cities need some means of disposing of the snow which is banked up in their streets; there is room for improvement in anti-friction bearings; good and cheap household filters would sell well; gas-meters are not what they ought to be, and water-meters will bear simplifying and cheapening; artificial stone is not yet perfect; steam-pumps, generally, are extravagant of fuel; Delawareans would give any price for a machine to reduce by two-thirds the number of blossoms on their peach-trees, in "overbearing years;" the leading calender roll-maker in the world says that there is not a really good emery wheel known to him; type-setting and justifying machines are a great desideratum; cast-iron gas and water pipe will some day be superseded; belts do not convey enough power; American bottles will not stand sufficient pressure to be used for champagne; thousands of firms would buy good simple "type-writers" if they were rapid in action for short letters; "printing telegraphs" for general use are unreliable and expensive; there is no blue pigment that can be worked up in rubber goods.

The foregoing list, taken "helter-skelter," might be increased ten-fold, by adding matters within our own cognizance, but concerning which no inquiry has recently reached this office.—*The Polytechnic Review*.

TRANSMISSION OF OBSERVATIONS IN TIMES OF THUNDERSTORM.

THE establishment of a meteorological observatory on the summit of Puy-de-Dôme, and its telegraphic connection with the observatory of the plain, situated at Clermont Ferrand, have enabled M. Germain (says *Les Mondes*) to make, during very violent thunderstorms, tests as conclusive as interesting, as to the efficacy of the lightning-conductors used in telegraphy.

1. Those with multiple points would be at a maximum of efficacy, if, instead of consisting of two rectangular plates furnished with points arranged parallely, they were composed of two bands in spiral, so that the line and the earth might be opposite and in presence of each other over a large extent by means of the points.

2. Those based on the calorific properties of electricity are dangerous by reason of the frequent isolations resulting from fusion of the wire, or the bad communications which too delicate mechanisms form inopportunely with the earth. Thus, the telegraphic receivers are sometimes put out of use, the operators struck with lightning, and the line rendered useless at the moment most indispensable for the exchange of correspondence. The putting of the line to earth being the only state of inoffensive electric discharge, M. Germain first experimented with an instrument which realises this automatically at each lightning discharge, and restores the other state immediately after. These arrangements are simple and ingenious. Whereas, in the direct discharges, the protecting wire, breaking, allows a certain quantity of fluid to escape to earth; in the discharges by introduction, the movement is so rapid, that the wire has no time to redden and break.

Several leaves of gold were arranged on a metallic frame connected with the line, at a very small distance from each other, so that the fluid, reaching the extremity of the leaves, made them repel each other. This separation being made as small as possible, the line was connected to earth. The same powerlessness to prevent the passage of the fluid by introduction, through the telegraphic receiver, was demonstrated. Moreover, the heat of the leaves injured their elasticity.

M. Germain more successfully employed a

system of coils, with three or four spirals of thick wire wound on a cubic centimetre of soft iron. A light armature connected with the line, and communicating now with the receiver, now with the earth directly, is attracted during the strong discharges. This system of coils, however, with differential action relatively to the ordinary coils of telegraphs, was found at fault. In a violent thunderstorm it happened that there was not enough electric quantity to produce the magnetisation, and that there was enough of potential to burn the fine wires of the telegraphs.

To suppress all these inconveniences, it was necessary to arrange that the line should be permanently in direct communication with the earth, and that the exchange of correspondence should take place all the same. This M. Germain realised. In the first coils he experimented with, each row of spirals of wire of the same size was connected, on one hand, with the line, and on the other, with the earth, so that the current branched into twenty spirals, where it passed in quantity, which was greater the smaller the spirals. The smallest spirals were found to be precisely the most influential by their proximity. The effects obtained by this system, on a short line, well insulated, showed a powerful magnetic force.

For longer lines, where derivations can be had, the coils employed are formed as follows:—Round a cylindrical sheet of very thin, soft iron, is wound screw-wise a small plate of copper, the larger sides of which are covered with an incombustible dielectric, while the smaller sides are bare. The bare part faces the surface of soft iron, but does not touch it. Several sheets of iron, and several rows of copper plates, are thus arranged concentrically. Their length varies according to the diameter. The entire coil is 12c. in length, and ·03c. in diameter. The magnetism is acquired by a polar plate, where the real poles of the armature meet the real poles of the electro-magnet.

From the experiments made it results that the magnetic force of each sheet is sensibly the same, and that all combine magnetically. The sums of the real spirals, whose number is very limited, form a number of spirals with action four times as great; this is one reason why the resistance may be considerably reduced without changing the effect produced.

M. Germain having found, on the other hand, that the resistance of conductors is inversely proportional to their surface, and not to their volume, has given the conductor of the coil the geometrical form which offers the greatest surface with the smallest volume. A thin sheet fulfils these conditions; it is easy to obtain, to cover, and to wind.

All the soft irons communicating with the earth, and all the bare spirals being opposed, at a very small distance, then, when electricity of high tension comes into the bobbin, not only does it find only two ohms of resistance, in place of 500 to 1,000 in other systems, but it can turn to the earth throughout all its course.

The dielectric is incombustible, that it may not be deteriorated by the small sparks which might pass in the interior.

With such a system, atmospheric electricity comes into telegraph stations with about the sixth, at the least, of potential; it finds a conductor seventy-five times less resistant, and consequently seventy-five times less susceptible of being heated. The magnetic effects produced are the same.

Such, in short, is the ingenious invention of M. Germain. And it has not remained at the stage of theoretic conception. For nearly six months employed in the correspondence between the observatory of Puy de Dôme and the town of Clermont Ferrand, it has acquired the sanction of a long practice. M. Germain has received numerous orders. At present, when observations at high altitudes are multiplying, it is important to be able to communicate permanently with the region of storms. In devising his coils and applying them to the Morse apparatus, M. Germain has rendered a great service to science, and overcome the chances of danger which threaten telegraphists in such circumstances.

Electrical Science in Foreign Journals.

COMPTES RENDUS OF PARIS ACADEMY.
NO. 23: 4TH DECEMBER, 1876.

New Method for studying Calorific Spectra. BY M. AYMONNET.

THE heat-source being constant, one may, even with a pretty large aperture of thermopile, find very approximately the quantities of heat in spectral portions smaller than this aperture. Thus, with one millimetre of aperture, advance the pile two-tenths of a millimetre at a time, taking account of the part left and the new part embraced. Let 1, 2, 3, 4, 5, 6, 7 . . . be successive parts of the spectrum, each 0·2 mm. in width; o, a, b, c, d, e, f. . the deflections produced by the pile, when it occupies the positions 1 to 6, 2 to 7, 3 to 8, 4 to 9, 5 to 10. . . Then, the pile at 1 to 6 not indicating heat in the spectrum, the quantity a it indicates when at 2 to 7 is produced by portion 6 of the spectrum; $b - a$, $c - d$, $d - c$, $e - d$ are due to the parts 7, 8, 9, 10; and $a + f - e$, $b - a + g - f$, $c - b + h - g$. . . are to be attributed to the action of 11, 12, 13. . . By this method, the author finds that a heat-source, giving a continuous luminous spectrum through a prism-spectroscope, gives through a refringent flint system a heat-spectrum with perceptible minima, which have a remarkable periodicity, and are displaced when the temperature of the source varies. They also change in position and breadth, and increase in number (but still show periodicity), when a trough of liquid is interposed. In the case of absorption spectra or mixture of two liquids, or of a solid and a solvent, &c., the heat-spectrum is constantly modified for some time.

NO. 24: 11TH DECEMBER.

No papers on electrical subjects.

DINGLER'S POLYTECHNISCHES JOURNAL.
SECOND AUGUST NUMBER, 1876.

Duplex Telegraphy with the Hughes Apparatus according to Maron's Method. By MM. GRIMMEST and CANTER.—Reserved.

Performances of the Gramme Electro-dynamic Machine.

An account of Prof. Hagenbach's experiments, already noticed by us (vol. iv., p. 250).

Acoustic Signals in Mines.

FIRST SEPTEMBER NUMBER.

Account of Trouvé's Military Telegraph (French) and Sawyer's Copying Telegraph (American).

On the Hardening of Steel. By M. JAROLIMEK.

SECOND SEPTEMBER NUMBER.

Siemens and Halske's Automatic Current-senders, for Telegraphic Quick Writing. (See vol. iii.)

Galvanometer for Testing Lightning-Conductors. By Dr. BUCHNER. (Vol. iv., p. 279.)

Contributions to Knowledge of the Newer Blasting Agents. By M. HESS.

FIRST OCTOBER NUMBER.

Telegraphic Duplex Arrangement with Translator. By M. KOCH. (Vol. iv., p. 290.)

Krizik's Electric Distance Signal. By M. KOHLFÜRST.

One special advantage in this arrangement is that the transmission of motion from the wheel-work to the disc-spindle occurs so high up, and immediately under the signal disc. In this way the power of external forces (*e.g.*, wind), which are apt to act prejudicially on the disc and the wheel-work, is reduced to a minimum; the signal is accordingly very reliable in stormy weather.

A Hydro-Electric Stand-Battery. By M. MÜNCKE.

This is a simple arrangement without much novelty.

Velocity of Electricity.

Short abstract of a lecture by Dr. W. Siemens on his new method of measuring this velocity. Dr. Siemens has shown that electricity, like light, is propagated in a conductor with measurable velocity, which is independent of electro-static or jar-retardation, and that this velocity for iron wires is about 31,000 miles, or 240,000km. in a second.

SECOND OCTOBER NUMBER.

Phelps' American Combination Type-Printer.

On the Employment of Electricity and Pieces of Zinc against Boiler Incrustation. By M. FISCHER.

FIRST NOVEMBER NUMBER.

On the Employment, &c. (conclusion of last-named paper).

This paper is an instructive *resumé* of what has hitherto been done on the subject. The author is of opinion that people had better give up looking to such anti-incrustators, and follow what seems to him the only rational means of avoiding incrustation: *Purification of the feed water before it comes to the boiler.* Whether this should be effected by means of chloride of barium, soda, or milk of lime, whether after Dettmar's or Schulze's method, can only be determined in each separate case after accurate chemical analysis.

Melsen's Rhe-electrometer.—Already noticed.

FIRST NOVEMBER NUMBER.

On the Theory of Translation. By M. ZETZSCHE.

ANNALES TÉLÉGRAPHIQUES.

SEPTEMBER-OCTOBER, 1876.

The Automatic Telegraph of Sir Charles Wheatstone.—A detailed account by M. Carème.

POGGENDORFF'S ANNALEN DER PHYSIK UND CHEMIE.

No. 7: 1876.

On Dielectric Polarisation. By Dr. ROOT.

1. There is a dielectric polarisation, which takes less than 0·0000821 seconds to be fully developed. 2. All solid dielectric bodies, sulphur *not* excepted, show, with continuous charge or slow communication, a dielectric reaction, which, *e.g.*, in arragonite, is perceptible within 0·0208 sec., but beyond 0·007 sec. can no longer be traced. 3. As regards direction and relative size, Fresnel's principal axes of elasticity and Maxwell's principal axes of electro-elasticity exactly coincide. 4. Only with the aid of Faraday's assumption, that a perfect conduction everywhere accompanies polarisation, is the equation $K = n^2$ (dielectric permeability = square of the index of refraction of light), to be brought into harmony with experience.

On the History of Weber's Law. By M. ZÖLLNER.

No. 8: 1876.

On the Physical Relations between Hydro-dynamic and Electro-dynamic Phenomenon. By M. ZÖLLNER.

Diaphragm currents and their modifications owe their origin to the occurrence of electro-motive forces of such a nature, that the electric current these produce in the moved liquid, so long as the latter is in contact with the canals of the diaphragm or the capillary tube, is always opposed to an electric current, which would drive the liquid in the same direction as the mechanical pressure through the diaphragm.

On the Electric Conductivity of Manganese and Carbon. By M. BEETZ.

The conductivity of manganite and pyrolusite was found very small (the former 0·0000016, and the latter 0·0000026, that of mercury being = 1); the conductivity of a concentrated sulphate of zinc solution would even be greater than that of the manganite. Of the five kinds of carbon examined, Nuremberg battery carbon, a piece of Faber's graphite-pencil, Munich retort carbon, a carbon plate of Ruhmkorff, and a carbon bar of Duboscq, the Paris carbons were by far the best conductors. The successive numbers for these five specimens are 0·00017, 0·00455, 0·0110, 0·0138, and 0·0288.

Reply to the Article by M. Holtz on Electro-machines of Ebonite. By M. SCHLÖSSER.

ANSWER TO QUERY.

The recommendations of the Committee on Postal Telegraphs have not, we are informed, up to the present been adopted. We are therefore unable to answer E. T. G.'s inquiry.—ED.